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Cordless local area network having a fixed central control device

Abstract:

PCT No. PCT/EP92/02230 Sec. 371 Date Jun. 2, 1994 Sec. 102(e) Date Jun. 2, 1994 PCT Filed Sep. 28, 1992 PCT Pub. No. WO93/07684 PCT Pub. Date Apr. 15, 1993The network enables data to be communicated by radio, in accordance with the Digital European Cordless Telecommunications (DECT) standard, between a plurality of user stations (T), through a central control device (C) . Each user station (T) comprises a data terminal (PC), a mobile radio module (MRM) and an adaptor device (LM) which acts as an interface between the data terminal (PC) and the mobile radio module (MRM). The central control device (C) comprises a microprocessor concentrator (MC) and a plurality of radio modules or bases (RB) connected to the microprocessor concentrator (MC) by connecting lines (L).
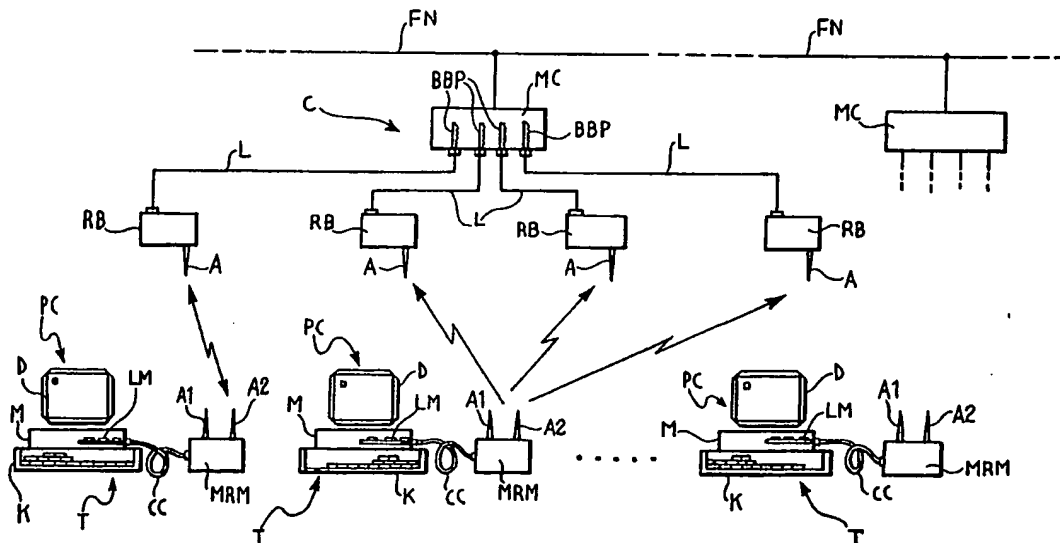

PCT

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| | | (43) International Publication Date: 15 April 1993 (15.04.93) |

(54) Title: CORDLESS LOCAL AREA NETWORK (RADIO LAN) WITH CENTRAL UNIT

(57) Abstract

The network enables data to be communicated by radio, in accordance with the DECT standard, between the data termi-
nals (PC) of a plurality of user stations (T), by means of a fixed central control device (C). Each user station (T) is associated with
a mobile radio transmitter/receiver module (MRM) which is separate and distinct from the data-terminal (PC), and with an
adaptor device (LM) which acts as an interface between the data terminal (PC) and the radio module (MRM) and which is physi-
cally incorporated in the data terminal (PC) and is connected to the radio module (MRM) by a flexible multicore cable (CC). The
central control device (C) includes a multiplicity of fixed radio modules or bases (RB) and a fixed concentrator (MC) which is
connected to the fixed radio bases (RB) by connecting lines (L).

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Cordless local area network (radio LAN) with central unit

The present invention relates to a local area network (a LAN) and, more specifically, to a network of the cordless (or wireless) type, particularly a network which operates in accordance with the DECT standard to enable data to be communicated by radio between a plurality of user stations each comprising a respective data terminal, by means of a fixed central control device.

Local networks have become increasingly widespread in the informatics and telematics world for short-range connections for enabling the transmission and distribution of data and services between a plurality of users within the same area, for example, in the same building. A local network enables many data terminals of different kinds, such as personal computers (PCs), minicomputers, printers, etc. to be connected in an extremely flexible manner, enabling very fast transmission speeds of the order of hundreds of thousands of Kbits/sec.

Up to now, most local networks have been of the wired type, that is, of the type in which the connections between the user stations and the central control devices are formed entirely by wires.

The appearance on the market of portable computers such as laptop personal computers, has created a need for cordless LANs.

A cordless local area network reduces installation costs because it eliminates the need to install connecting cables. This type of network can also be

formed in situations in which it would be difficult or impossible to install connecting wires, such as, in buildings which do not have sockets for LANs or in which there are architectural constraints.

A cordless LAN network may represent the ideal solution in an organisation in which the positions of the user stations or the number of stations connected in the network are subject to frequent changes or modifications.

A cordless LAN also represents the ideal solution for organisations which are subject to frequent changes of location. In this case, it would in fact be neither practical nor economical to transfer a wired LAN.

Finally, as stated above, a LAN network enables data to be communicated even by portable personal computers, without limiting the mobility of these new devices.

The network according to the invention operates in accordance with the DECT (Digital European Cordless Telecommunications) standard developed by ETSI - the European Telecommunications Standards Institute - which defines the specifications for radio connections between users and a network in a private environment.

The DECT system operates in the band between 1880 MHz and 1900 MHz and provides for radio transmission by means of a hybrid time and frequency multiplex system.

The characteristics of the DECT standard are described, for example, in "Digital European Cordless Telecommunications Services and Facilities", ETSI DR/RES 3003, June 1991 and in "Data Services in DECT",

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A. Bud, Fifth International IEE Conference on Land
Mobile Radio, Warwick, December 1989.

The cordless local area network according to the
invention is characterised in that the data terminal of
each user station is associated with:

- a mobile radio transmitter/receiver module which is
separate and distinct from the data-terminal, and

- a microprocessor adaptor device for acting as an
interface between the data terminal and the associated
mobile radio module, the adaptor device being
incorporated physically in the data terminal and
connected to the mobile radio module by a flexible
multicore cable,

and in that the central control device includes:

- a multiplicity of radio modules or bases for
installation in respective predetermined fixed
positions and for transmitting/receiving packets of
data to/from the radio module of one or more user
stations, and

- a microprocessor concentrator (hub) which is intended to be
installed in a fixed position and to be connected to
the fixed radio bases and which is programmed to
control the communications between the user stations by
means of the radio bases, according to predetermined
procedures and protocols.

Typically, the data-terminals of the user stations may,
for example, be personal computers and the
microprocessor adaptor device is conveniently produced

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in the form of a "half-size"-format card or daughter
board incorporated in the PC and connected to the bus
thereof. The electrical supply for the adaptor is thus
conveniently derived from the data-terminal bus.

Moreover, the transmitter/receiver radio module to
advantage takes its electrical supply from the
associated adaptor board by means of conductors which
extend through the flexible multicore cable connecting
it to the board.

To advantage, each user station radio
transmitter/receiver module has two omnidirectional
antennae for achieving space "diversity" to improve the
characteristics of the radio connection with the fixed
radio modules or bases.

Conveniently, but not necessarily, the fixed central
control device may be arranged for connection to a
fixed network, for example, an Ethernet network or a
Token Ring or RS232 network.

Further characteristics and advantages of the invention
will become clear from the following detailed
description of a cordless LAN network operating in
accordance with the DECT standard, the description
being given with reference to the appended drawings,
provided purely by way of non-limiting example, in
which:

Figure 1 is a block diagram of the LAN network,

Figure 2 is a circuit diagram showing the structure of
an adaptor and a mobile radio module associated with
each data-terminal of the LAN network shown in Figure

1,

Figure 3 is a time/frequency diagram relating to the
manner in which radio transmission is effected
according to a hybrid TDM/FDM system in the LAN network
of Figure 1, and

Figure 4 shows an example of a frame for an asymmetric
multi-bearer connection which can be formed in the LAN
network of Figure 1.

With reference to Figure 1, a cordless local area
network LAN formed in accordance with the
specifications of the DECT standard includes a
plurality of user stations T and a fixed central
control device, generally indicated C.

Each user station T includes a respective data terminal
which, in general, may be constituted by any device,
such as a processor, a printer, etc., which can send
and/or receive digital data by means of a
communications network. In the embodiment shown by
way of example in Figure 1, the data terminals of the
user stations T are constituted by personal computers
PC having standard network and applications software of
the LAN Manager type. The personal computers may, for
example, be Olivetti 1/D33 devices, each including a
keyboard K, a display screen D and a processing module
M.

Each data terminal PC is connected to a respective
mobile radio transmitter/receiver (transceiver) module
indicated MRM, of a type conforming to the DECT
specifications for the physical layer.

The processing module M of each data-terminal PC incorporates a respective microprocessor adaptor device, indicated LM. The microprocessor adaptor is suitable for acting as an interface between the respective data terminal and the associated mobile radio module MRM. For this purpose, as shown schematically in Figure 2, the microprocessor adaptor LM is connected to the data bus DB of the processing module M of the data terminal. The adaptor LM is also connected to the mobile radio module MRM associated with the data terminal by means of a multicore flexible cable CC (Figure 1 and 2).

The central control device C includes a multiplicity of fixed radio modules or bases FRM installed in respective predetermined fixed positions for transmitting/receiving packets of data to/from the mobile radio module MRM of one or more user stations T.

The radio bases RB are connected, for example, by electrical wires L, to a microprocessor concentrator MC which is installed in a fixed position and is programmed to control the communications between the user stations T by predetermined procedures and protocols, in accordance with the DECT standard, by means of radio connections established between the mobile radio modules MRM and the radio bases RB.

Preferably, but not necessarily, the concentrator MC may be arranged for connection to a fixed network FN, for example an Ethernet network or a Token Ring or RS 232 network. Concentrators MC of other local networks LAN may possibly be connected to the fixed network.

The integrated system described with reference to

Figure 1 can perform the function of an MAC (medium
access control) level multi-port bridge to enable the
user stations T to transmit and receive packets of data
which are packaged in accordance with the DECT standard
format and are exchanged by radio, by means of the
fixed portion C of the system. This portion acts as a
very rapid packet-switching system and directs the
packets received towards the destination user stations
or towards the wired network FN.

The system described operates in accordance with the
DECT standard. The DECT standard connection between
the user stations T and the fixed portion C of the
system replaces only the MAC level of the Ethernet
system.

By virtue of the lines L, the radio bases RB can be
installed up to distances of the order of 100 metres
from the concentrator MC. By carrying out functions,
such as connection handover, which are provided for in
the DECT standard, almost complete continuity of
service between the two or more radio bases RB used can
be established.

The concentrator MC may be constituted, for example, by
an Olivetti M300 personal computer with an Intel 386Sx
processor operating at 16 MHz.

This concentrator incorporates baseband processors BBP
connected in an orderly manner to respective associated
radio bases RB.

Conveniently, the baseband processors BBP of the
concentrator MC and the interface adaptors LM of the
user station T may be in the form of half-size format

PC circuit boards and, in practice, may conveniently have the same structure at the hardware level and be differentiated only at the software level. The structure of an interface adaptor LM of a user station will be described in greater detail below with reference to Figure 2.

The concentrator MC as a whole is responsible for controlling the entire system and, in particular:

- the functioning of the high levels of the DECT protocols,

- the control of the various resources of the network,

- the switching of the packets of data, and possibly

- the interfacing between the cordless network LAN and the wired network FN.

The high levels of the DECT protocols provide for services such as fast handover, user authentication and the creation of virtual connections which enable physical connections to be established without massive exchanges of data.

Before the merits of the structure of the functions of the LM devices and of the band base processors BBP are discussed further, some characteristics relating to the mobile radio modules MRM and to the radio bases RB will be set out.

Structurally, the modules MRM and RB are almost identical. As already stated they are transceivers conforming to the DECT specifications for the Physical

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Layer.   In accordance with the DECT specifications,
the radio modules operate in the band between 1880 MHz
and 1900 MHz on ten channels spaced at 1.728 MHz
intervals.

Typically, the modules can instantaneously transmit a
power of about 250 mW with an envisaged activity cycle
according to the DECT standard of between 4% and 96%.

The modules can transmit signals modulated according to
filtered Gaussian FSK which is a non-coherent version
of GMSK in which BT = 0.5 (BT is the product of the
bandwidth B of the filter used and the duration T of
the individual symbol).

Radio communications between the MRM modules and the
radio bases RM take place according to a hybrid time
and frequency multiplex system (TDM/FDM) with double
simplex and duplex connections.

Transmission takes place within time cycles or frames
having durations d of (for example) 10 ms, divided (for
example) into 24 slots, of which, in accordance with
the DECT specifications, a first half (12) normally
serve for transmissions from the radio bases RB to the
portable radio modules MRM and the second half (12) for
transmissions in the opposite direction.

Figure 3 shows the grid of the slots (240) available
with ten channels for each frame.   In the grid, the
time t is indicated on the abscissa and the frequency f
is indicated on the ordinate.   The frequencies
associated with the ten channels are indicated f_1-f_{10}
and the slots into which each individual frame is
divided are numbered 1-24.

With frames each of 10 ms divided into 24 slots, each slot has a duration of 416.667 μs of which 364.667 μs can be used for a packet of data and 51 μs as a time interval (a guard space).

Conveniently, a time-division duplex (TDD) is used for duplex connections and slots at all the frequencies are used for multiple connections.

The radio modules MRM and RB therefore need to be able to retune themselves between two channels at opposite ends of the band and to switch between transmission and reception within the time interval (the guard space) between two slots.

The receiving portions of the radio modules MRM and of the radio bases RB conveniently have superheterodyne architecture with a single conversion stage.

As is clear from Figure 1, each radio base RB has a respective antenna A and the mobile radio modules MRM of the user stations each have two antennae A1 and A2 for achieving space diversity in order to improve the quality of the radio connections.

In the embodiment shown in Figure 2, each interface device LM associated with each data terminal includes a main microprocessor 50 and a signal processor 51.

The main microprocessor 50 which is constituted, for example, by a V40 device produced by Nippon Electric Company, can converse with the bus DB of the associated data terminal by means of a dual-port RAM memory 52 and with the other microprocessor 51 by means of another dual-port RAM memory 53.

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The microprocessor 50 is associated with a program memory 54, for example, of the EPROM type and a RAM buffer memory 55 for the data.

The microprocessor 50 and the memory 55 are associated with a device 56 for controlling the interfacing with the memory and decoding the I/O ports. This device is conveniently formed as a large-scale integration ASIC integrated circuit (an application-specific integrated circuit).

The microprocessor 51 is a device for processing digital signals, for example, a TMS320 device produced by Texas Instruments and is programmed to control low-level MAC functions such as the formatting and deformatting of the frames and of the slots, the synchronisation of slots and frames, the detection of errors, the scanning of the communication channels, etc.

The processor 51 is also connected to a device 57 which extracts the clock signals from the signals received by the mobile radio module MRM and generates the timing signals and also effects any coding for protecting the data to be transmitted. The device 57 may also conveniently be produced in the form of a single ASIC integrated circuit.

This device is associated with a buffer 58 which acts as a protection latch. The processor 51 is connected by means of the buffer and the multicore cable CC to a device 59 within the mobile radio module MRM for controlling the radio transmission/reception circuits 60. The device 59 may also conveniently be produced in the form of an ASIC integrated circuit.

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Conveniently, the device LM draws its electrical supply from the bus DB of the data terminal, for example, by means of the two conductors indicated 60 in Figure 2. Moreover, the electrical supply of the mobile radio module MRM to advantage is derived from that of the adaptor device LM, for example, by means of two conductors indicated 61 in Figure 2, which extend through the multicore interconnecting cable CC.

As stated above, from a hardware point of view, the baseband processors BBP of the concentrator device MC have the same structure as the logic modules LM fitted in the data terminals of the user stations T. In fact most of the functions of the baseband processors correspond to functions carried out by the modules LM. These functions include, in particular:

- the creation and dismantling of the slot structures,

- the creation and dismantling of logic channels,

- the monitoring of the free channels in the incoming communications,

- the propagation of "connectionless" and "paging" messages,

- handover between logic and "inter-cell" channels,

- the control of rapid procedures for detecting and correcting errors.

The interface adaptors LM of the data terminals are arranged also to perform the following functions:

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- the creation and updating of a map of the usage of the physical communications channels and the selection of the channel for each connection to be established, and

- the decision to effect either intra-cell or inter-cell handover and the initiation thereof.

The adaptor modules LM also act as interfaces between the DECT environments and the applications environments of the respective data terminals. The module LM thus responds to the network operating system (the LAN manager) resident in the data terminal in exactly the same manner as an Ethernet network adaptor by means of a Microsoft Network Driver Interface Specification standard interface.

Two critical requirements for the application of the DECT specifications in a local area network LAN are the need to use the spectral resources with maximum efficiency and the need to minimise the delay introduced by the DECT. In order to achieve both these objectives, it is necessary to use specific protocols.

Since the data traffic is characterised by short transactions interposed between long silences it is inconceivable to keep the connections between the user stations and the radio bases open permanently since they would be massively underused. The radio connections are therefore established in the network only when there are data to transmit and are closed during periods of inactivity in order to free radio channels for use by other users.

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For this purpose, the main processor 50 of each module LM is programmed to operate in the following manner.

Each time data are admitted to the buffer memory 55 for transmission by means of the associated mobile radio module MRM, the main microprocessor 50 sets up a radio connection by means of the microprocessor 51 (with a radio base determined in the manner which will be described below and with the use of slots of a channel or frequency determined in the manner which will also be described below). The radio connection thus opened is maintained throughout the time necessary for the transmission of the data in the memory 55. After the data have been transmitted the radio connection is not closed immediately but is kept open for a predetermined period of time. Conveniently, the main microprocessor 50 is arranged to process a short-term statistic relating to the communications traffic of the data terminal (for example, over a period of half an hour or an hour). The radio connection opened for the transmission of data is then closed with a delay after the moment at which the transmission of data is completed, the delay being determined adaptively on the basis of the mean traffic which has affected the data terminal. This reduces useless periods since, in many cases, it is not necessary to reopen the radio connection when a further flow of data arrives for transmission.

In order to select the radio base with which to establish the connection, each user station adaptor module LM operates in the following manner.

In accordance with the DECT standard, the main microprocessor 50 of the adaptor (LM) of each user

station is arranged cyclically to scan all the slots of
all the channels by means of the associated mobile
radio module MRM in order to detect the level of the
signal emitted by each fixed radio base RB in each slot
for each channel or frequency. On the basis of the
levels of the signals thus detected, the microprocessor
50 can establish which is the nearest fixed radio base
RB.   The processor is also arranged, during the
scanning, to decode the signals indicative, for each
slot, of the radio base RB which is (possibly) active.

By virtue of this "mapping", in order to transmit data,
the main processor 50 of the device LM of each user
terminal can select the nearest radio base of which not
all the slots are occupied at the time in question.

This procedure avoids futile attempts to establish a
radio connection with a radio base which, although it
is the nearest, is fully occupied at the time in
question.

In accordance with the DECT standard, the baseband
processors BBP of the concentrator device MC are
arranged to scan the channels or frequencies f_1 - f_{10}
cyclically by means of the associated radio bases RB.
In particular, the scanning takes place in synchronism
with the cyclical scanning effected by the devices LM
of the user terminals.   Moreover, the main processors
50 of the interface adaptor modules LM are arranged to
carry out the scanning one channel in advance.   In
other words, if, in the course of their scanning, the
fixed radio bases RB are "interrogating" the channel or
frequency f_i, at the same moment, the mobile radio
modules are "interrogating" the channel or frequency
f_{i+1}.

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This minimises the time needed to establish a radio connection between a user terminal and a fixed radio base.

Conveniently, the main processors 50 of the interface adaptors LM of the user stations and the baseband processors BBP of the concentrator MC are arranged to carry out the DECT Multibearer and Asymmetric Connection procedures in order to determine in which slot to transmit.

The multibearer procedure enables several slots (bearers) to be assigned simultaneously to the connection associated with a single user station. The bandwidth available for a user station may thus be increased from, for example, 32 kb/s duplex (single bearer) up to (theoretically), for example, 384 kb/s duplex with all twelve pairs of slots (12 bearers) in use.

Since the traffic in a local area network is typically very asymmetrical with the need to have considerable bandwidths available in one direction in particular, the DECT specifications include mechanisms which enable the uplink and downlink slots of a connection to be used in a single direction. A connection of this type must form part of a multibearer connection in which at least one other connection remains duplex to provide a route for control data in the opposite direction. The result is that a user can access almost the whole of the bandwidth (352 kb/s) by occupying half of the slots as shown in Figure 4, which relates to an asymmetric multibearer connection (5, 1).

Finally, the software used in the network LAN

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conveniently includes procedures for detecting and correcting errors in accordance with the DECT specifications. The specifications provide for, at the level 2 (MAC/DLC), some mechanisms which have been developed appropriately for this purpose, and the main characteristics of which are the following:

- the MAC provides a service defined as an "Ip" (a protected information channel) with a throughput of 25.6 kb/s per connection and an error factor of 10^{-5}; this service is based on a retransmission mechanism which is quick and simple by virtue of the use of a single window packet;

- the DLC (data link control) provides a service defined as "Frame Relay" which protects the data against any errors introduced during handover and connection changes and against residual errors of the Ip channel.

Naturally, the principle of the invention remaining the same, the forms of embodiment and details of construction may be varied widely with respect to those described and illustrated purely by way of non-limiting example, without thereby departing from the scope of the present invention.

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CLAIMS

1. A cordless local area network (LAN) for enabling
data to be communicated by radio between a plurality of
user stations (T) each comprising a respective data
terminal (PC), by means of a fixed central control
device (C), in accordance with the DECT standard,

characterised in that the data terminal (PC) of each
user station (T) is associated with:

- a mobile radio transmitter/receiver module (MRM)
which is separate and distinct from the data terminal
(PC), and

- a microprocessor adaptor device (LM) for acting as an
interface between the data terminal (PC) and the
associated mobile radio module (MRM), the adaptor being
incorporated physically in the data terminal (PC) and
connected to the mobile radio module (MRM) by a
flexible multicore cable (CC),

and in that the central control device (C) includes:

- a multiplicity of radio modules or bases (RB) for
installation in respective predetermined fixed
positions and for transmitting/receiving packets of
data to/from the mobile radio module (MRM) of one or
more user stations (T), and

- a microprocessor concentrator (MC) which is intended
to be installed in a fixed position and to be
connected, by connecting lines (L), to the fixed radio
bases (RB) and which is programmed to control the

communications between the user stations (T) by means
of the radio bases (RB), according to predetermined
procedures and protocols.

2. A local area network according to Claim 1, in which
each data terminal (PC) includes a data bus (DB), the
network being characterised in that the microprocessor
adaptor (LM) associated with each data terminal (PC)
includes:

- means (51-58) for activating/de-activating the radio
connection,

- a buffer memory (55), and

- a main microprocessor (50) which is connected to the
data bus (DB) of the data terminal (PC), to the buffer
memory (55), and to the means (51-58) for
activating/de-activating the radio connection, the main
microprocessor (50) being arranged:

to control the exchange of data with the data terminal
(PC) in a predetermined manner,

to admit to the buffer memory (55) the data which are
to be transmitted by the associated mobile radio module
(MRM), and

to pilot the activating/de-activating means (51-58) in
a manner such as to activate a radio connection each
time data are stored in the memory (55) and to keep the
radio connection open for a predetermined period of
time after the transmission of the data in the memory
(55) has been completed.

3. A local area network according to Claim 2, characterised in that the main microprocessor (50) is arranged to pilot the activating/de-activating means (51, 57, 58) in a manner such that, upon completion of the transmission of the data in the memory (55), the radio link is kept open for a period of time which is determined adaptively on the basis of a communications traffic statistic relating to the data terminal (PC) and calculated over a predetermined period of time.

4. A local area network according to any one of the preceding claims in which, in accordance with the DECT standard, the radio communications between the mobile radio modules (MRM) and the fixed radio bases (RB) take place according to a mixed time and frequency multiplex system (TDM, FDM) on n channels or frequencies (f_1 – f_{10}) within a predetermined band with time cycles (frames) of predetermined duration, divided into a predetermined number (2m) of time slots, and in which the main microprocessor (50) of the adaptor (LM) of each user station (T) is arranged:

– to scan all the 2m x n slots of all the n channels (f_1 – f_{10}) cyclically by means of the associated mobile radio module (MRM) and to detect the level of the signal emitted by each fixed radio base (RB) in each slot for each channel or frequency and thus to determine which radio base (RB) is nearest the user station (T),

the network being characterised in that the main microprocessor (50) is also arranged, during the scanning, to decode the signals indicative of the radio base (RB) which is (possibly) active in each slot and to select – in order to transmit data – the nearest

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radio base (RB) for which not all the slots are occupied.

5. A local area network according to any one of the preceding claims, characterised in that the concentrator device (MC) includes a multiplicity of baseband processors (BBP) each of which is associated with and connected to a respective fixed radio base (RB) and is arranged to perform the functions up to level 2 of the hierarchy of DECT protocols.

6. A local area network according to Claim 5, characterised in that the baseband processors (BBP) are arranged to scan the transmission channels or frequencies (f_1 - f_{10}) cyclically, in accordance with a predetermined sequence, by means of the associated radio bases (RB), and in that the main processors (50) of the adaptors (LM) of the user stations (T) are arranged to scan the transmission channels or frequencies (f_1 - f_{10}) in synchronism with the baseband processors (BBP) but one channel in advance thereof.

7. A local area network according to any one of Claims 2 to 6, characterised in that the main processors (50) of the adaptors (LM) of the user stations (T) and the baseband processors (BBP) of the concentrator (MC) are arranged to effect the DECT multibearer and asymmetric connection procedures in order to determine the slots in which to transmit.

8. A local area network according to any one of the preceding claims, characterised in that the adaptor (LM) of each user station (T) is formed on a half-size format PC-AT circuit board.

9. A local area network according to one of Claims 5 to 8, characterised in that the baseband processors (BBP) are incorporated in the concentrator device (MC) and are supplied thereby.

10. A local area network according to any one of the preceding claims, characterised in that each mobile radio module (MRM) receives its electrical supply from the associated adaptor (LM) by means of the multicore cable (CC) which interconnects them.

11. A local area network according to any one of the preceding claims, characterised in that each mobile radio module (MRM) has a pair of antennae (A1, A2) for achieving space "diversity".

12. A local area network according to Claim 11, characterised in that each fixed radio base (RB) has a single antenna (A).

13. A local area network according to any one of the preceding claims, characterised in that the concentrator (MC) can be connected to a fixed network (FN) such as an Ethernet or Token Ring network and can converse therewith.

14. A local area network according to Claims 1 and 5, characterised in that the adaptors (LM) of the user stations (T) and the baseband processors (BBP) of the concentrator (MC) are formed by circuit boards which are identical from the hardware point of view but which are differentiated at the software level.

FIG. 1

FIG. 2

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FIG. 3
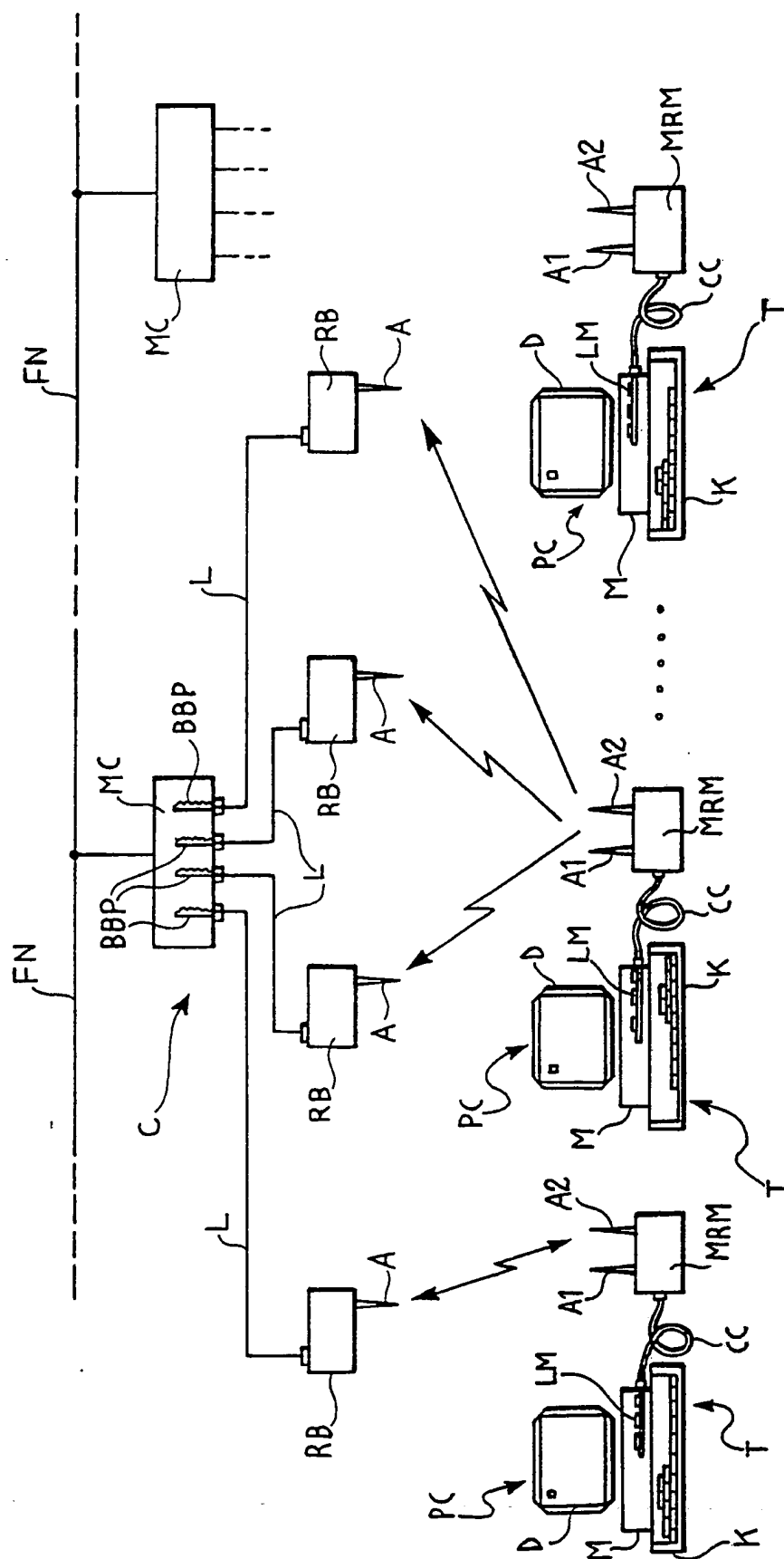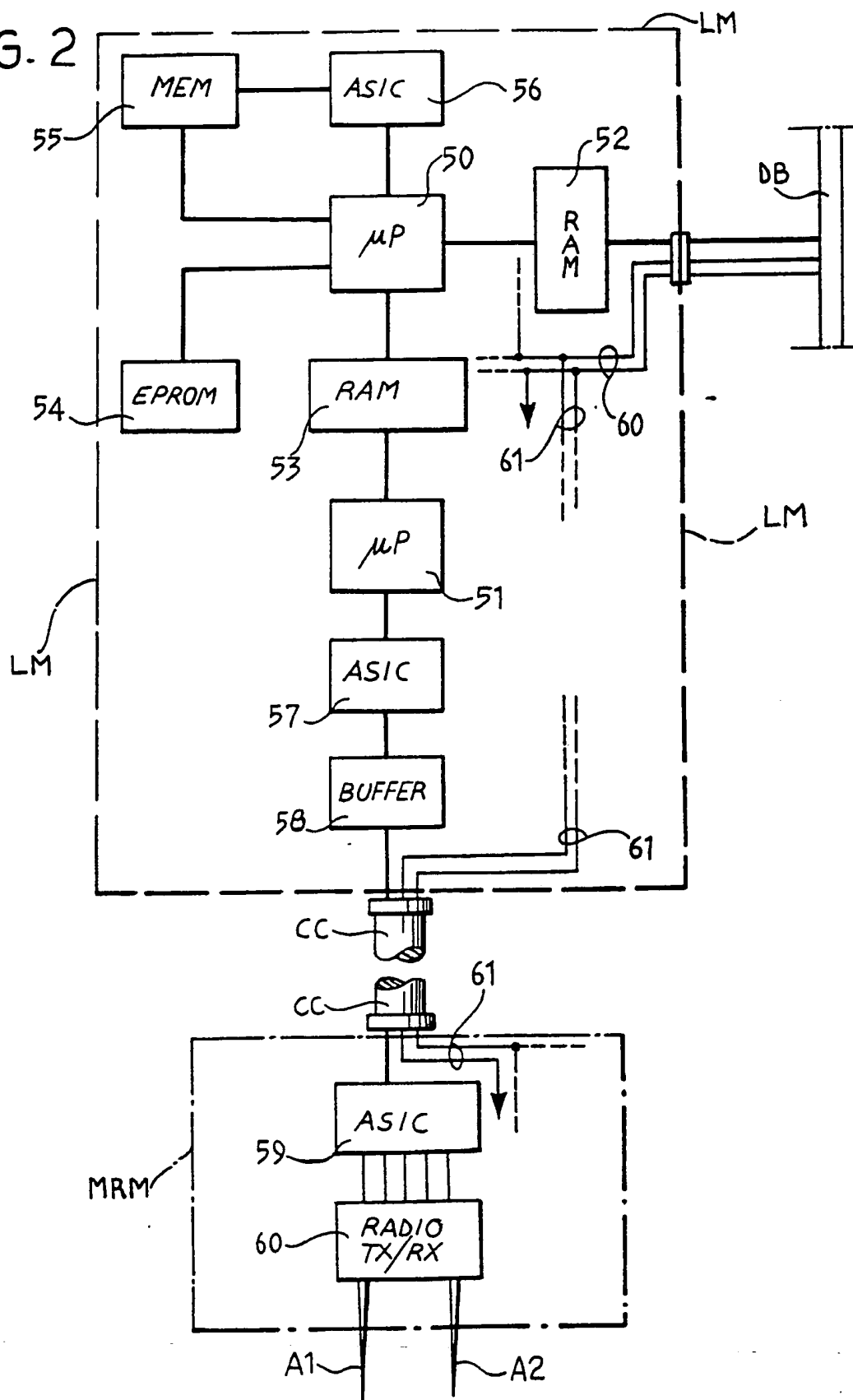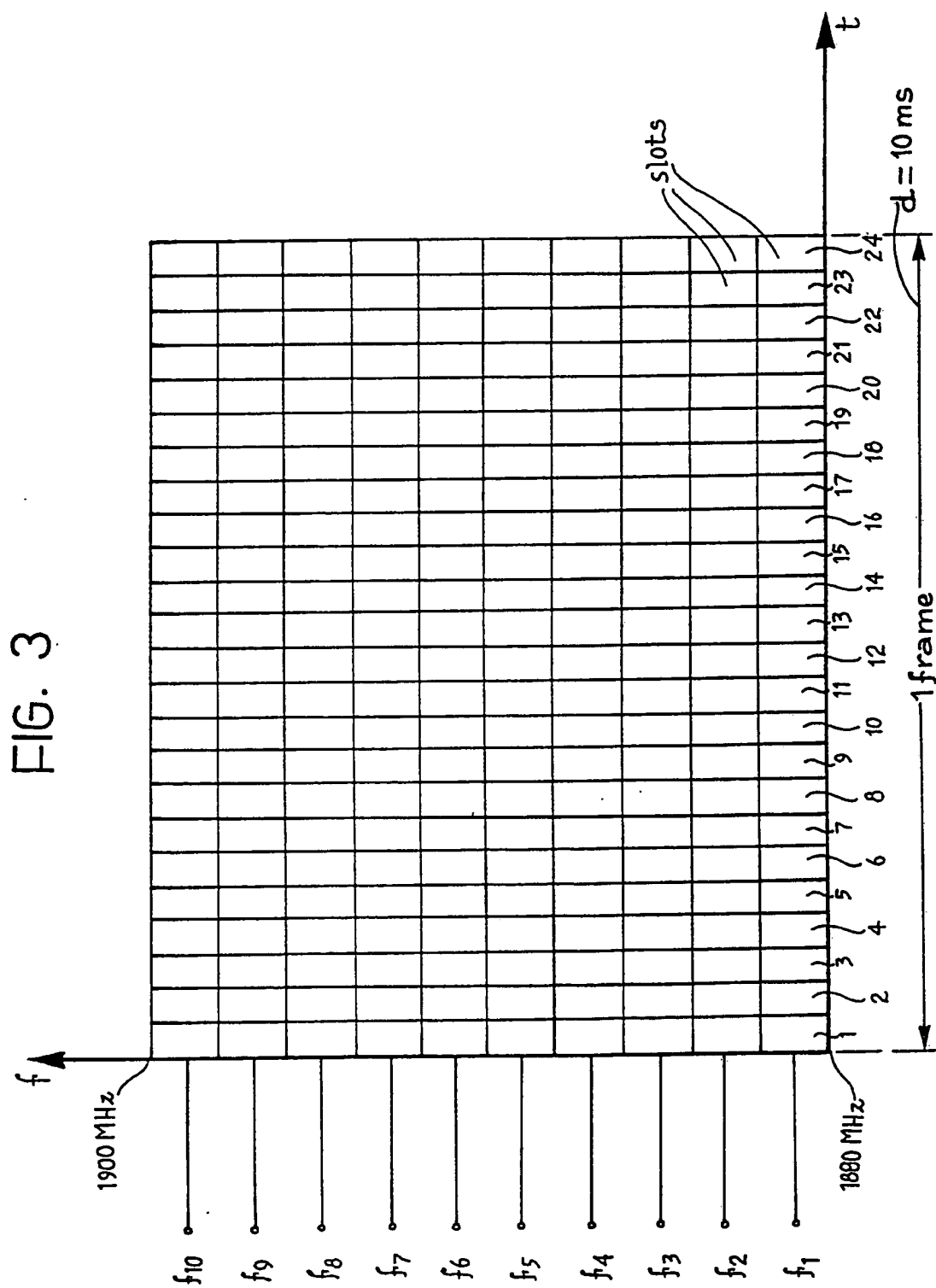
FIG. 4

SX = DOUBLE SIMPLEX

dX = DUPLEX
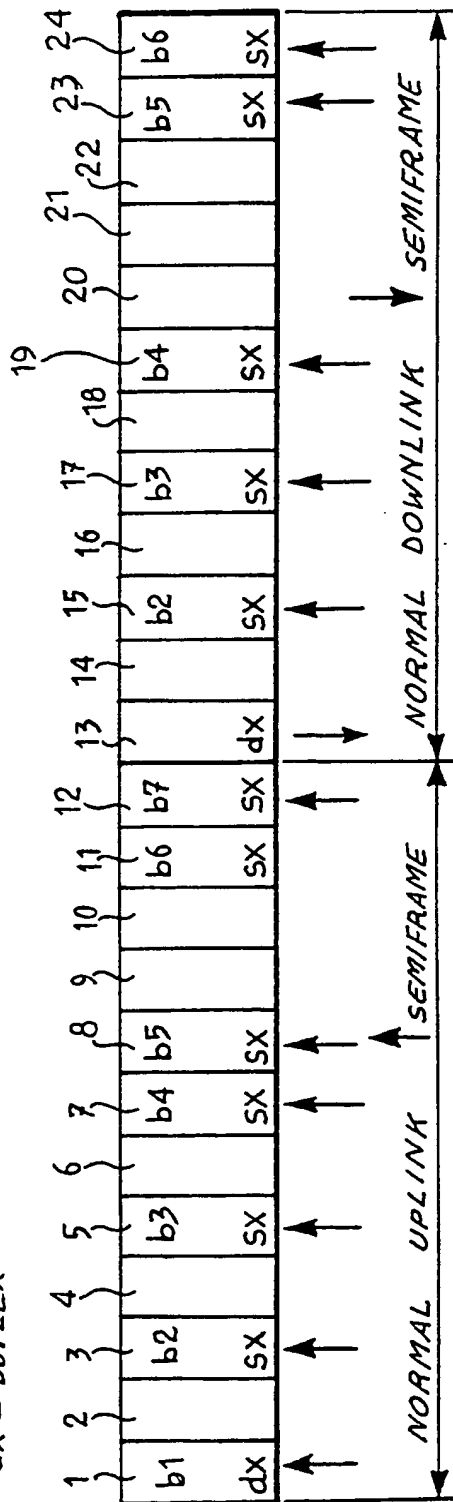
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
b1		b2		b3		b4	b5			b6	b7			b2		b3	b4					b5	b6
dx		SX		SX		SX	SX			SX	SX	dx		SX		SX	SX					SX	SX

NORMAL UPLINK | SEMIFRAME | NORMAL DOWNLINK | SEMIFRAME

INTERNATIONAL SEARCH REPORT

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) *

According to International Patent Classification (IPC) or to both National Classification and IPC

IPC⁵: H 04 B 7/24, H 04 H 3/00, H 04 L 12/44

II. FIELDS SEARCHED

Minimum Documentation Searched *

Classification System	Classification Symbols
IPC⁵	H 04 B 1/00, H 04 B 9/00, H 04 J 3/00, H 04 L 11/00, H 04 L 12/00, H 04 N 5/00, H 04 Q 7/00

Documentation Searched other than Minimum Documentation
to the Extent that such Documents are Included in the Fields Searched *

III. DOCUMENTS CONSIDERED TO BE RELEVANT *

Category *	Citation of Document, ** with indication, where appropriate, of the relevant passages **	Relevant to Claim No. **
E	US, A, 5 079 628 (TOMIKAWA) 07 January 1992 (07.01.92),	1,11, 12
P,A	see abstract; fig. 9; claims 1,10,15,18-20.	2-10, 13-14
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X	EP, A2, 0 257 947 (ATT) 02 March 1988 (02.03.88),	1,11, 12
A	see abstract; fig. 1; claims 1-4,7,8.	2-10, 13-14
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A	US, A, 4 665 519 (KIRCHNER et al.) 12 May 1987 (12.05.87), see abstract; fig. 1-3; claims 1-8.	1-14
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A	GB, A, 2 125 257 (PLESSEY) 29 February 1984 (29.02.84), see abstract; claims 1-3.	1-14

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"A" document defining the general state of the art which is not considered to be of particular relevance

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"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
28 December 1992	15 JAN 1993

International Searching Authority	Signature of Authorized Officer
EUROPEAN PATENT OFFICE	BLASL e.h.

International Application No PCT/EP 92/02230

III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)		
Category *	Citation of Document, " with indication, where appropriate, of the relevant passages	Relevant to Claim No.
A	-- DE, A1, 3 716 318 (BTS) 24 November 1988 (24.11.88), see abstract; claims 1,2,7-9. ----	1-14

| zum internationalen Recherchen-bericht über die internationale Patentanmeldung Nr. | to the International Search Report to the International Patent Application No. | au rapport de recherche inter-national relatif à la demande de brevet international n° |

PCT/EP 92/02230 SAE 64827

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